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FROM THE EDITOR'S DESK

By the time you read this edition, the summer will be nearly gone for much of North America and in most parts, the leaves will be starting to lose their green color as the fall foliage season commences. In our area, black gum (*Nyssa sylvatica*) and red maple (*Acer rubrum*) are among the earliest to show their colors. As I write this letter, some black chokeberry (*Photinia melanocarpa*) leaves are already turning orangish red in Massachusetts. For the December issue, I'd like to have reports from as many regions as possible across North America for "Notes from the Field" on when the leaves of various trees and shrubs begin to change colors and when they fall as well as what flowers are still present in the late bloomers and when all the flowers are gone, plus any observations of animal activity, especially bird migrations. For those of you in the Southern Hemisphere, you could submit comments on signs of spring that should begin as you read this issue. Meanwhile I hope folks in the Northern Hemisphere have had plenty of time to get out in the field to explore, study, and enjoy the marshes, swamps, fens, bogs and assorted other wetlands. I've spent quite a bit of time in the field this summer after having spent far too many hours in the office.

Ralph Tiner
WSP Editor

In this issue, you'll find important summaries of two SWS events with links to abstracts: one a regional workshop by the Rocky Mountain Chapter and the other a symposium on wetland restoration organized by the Society's Wetland Restoration Section. These are excellent examples of the kind of information that can be shared through *Wetland Science and Practice*. A special thanks to Andy Herb and Nate Hough-Snee for preparing these summaries. Presenters of various papers and authors of posters at the SWS conference are encouraged to submit 2-6 page summaries of their presentations for publication in WSP. Workshop and symposium abstracts as well as short summary papers allow members who couldn't attend the annual conference as well as those who went to different sessions and missed your presentation to learn what you are doing and how to contact you for more information. Through WSP you have the potential to reach the entire SWS membership.

Also included are a couple of articles outlining two approaches to begin monitoring salt marsh migration plus a summary of a recent report on U.S. prairie pothole wetlands. Although the former studies are currently focused in the Northeast, similar work could easily be initiated elsewhere along subsiding coastlines. New to this issue is "Wetland Bookshelf" – an attempt to introduce readers to some new books and publications of interest.

We're always looking for 2-4 page articles for future issues, so please consider writing up summaries of the projects you've been working on over the past few years. If you have questions about the relevance of a topic, feel free to contact me at: rtiner@eco.umass.edu.

Happy Swamping! ■

CONTENTS

Vol. 31, No. 3 September 2014

Cover photo:
Valley wetlands from Yellowstone National Park, Wyoming. (R. Tiner photo)

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PRESIDENT'S MESSAGE

Greetings from sunny Virginia and your humble president. The Joint Aquatic Sciences Meeting (JASM) in May was a huge success! The city of Portland, Oregon played host to over 2,926 participants representing over 50 countries. Attendees were able to select from 2,474 presentations. Students were there aplenty and they contributed a variety of both oral and poster sessions; thirteen were there as guests of the SWS Human Diversity Committee.

James E. Perry, PhD, PWS
SWS President

So, what is going on at SWS? Our E&O committee is initiating "Wetlands Treasures", an effort to bring to light the value of wetlands. Initially this effort will work with SWS chapters, state programs, RAMSAR, and other groups to identify and describe the ecological and societal values of significant wetlands. These wetlands will then be shared with our members and the general public through our new website at sws.org.

We have several efforts to write state of the art wetland papers underway. One of these is to provide insight into the use of the Floristic Quality Index and the other one on wetlands and fracturing. Neither of these is intended to be position papers, but rather informative two to three page papers on what we know and what we need to know in order to wisely manage our wetland resources. These state of the art papers will be shared with our members through our *Wetlands Science and Policy publication (WSP)*. Other wetland subjects that we would like to cover include the effects of global climate change on regional wetlands, monitoring and measuring the development of mitigation/compensation ecological functions, and coastal marsh dieback. If you have an idea for a wetland subject that you would like to include, or especially if you would be willing to lead an effort, please let me know.

Speaking of *WSP*, I'd again like to thank Andy Cole for his past work on the bulletin. He gave unselfishly of his time to produce a high quality, informative bulletin filled with wetlands news, information, and pertinent research. Thanks again, Andy! And with that, we welcome Ralph Tiner as the new editor of *WSP*. His energy is already proving to us that he intends to turn out a first rate publication.

I'd like to send a special thanks to Julia Cherry, Steve Faulkner, past members of the Executive Board, and our business office; we have now fully implemented the SWS investment policy. We began investing this spring, with Wintrust as our investment company, and it was completed by July. Steve presented this information to the members at the annual business meeting in Seattle, and the feedback we've received so far has been very positive. The Ways and Means committee is currently working on a matrix to determine the success of the investment portfolio. We will keep the membership informed of our efforts.

Our 2015 SWS Annual meeting is set for June in Providence, RI (my home state!). Scientific programming is being organized by repre-

continued on page 9

wetland science & practice

Front Row (left to right): Elizabeth Preza, Maite Martin, Randi Jackson, and Mia Dawson. Back Row (left to right): Khem Marriott, Julio Pachon, Keith Perkins, Nemesis Ortiz, Christin Carter, Kyra Barboza, and Philip Bellamy.

SWS Diversity Program Undergraduate Mentoring Awards

by Frank Day[1]

We have reached the 11-year mark of the SWS Undergraduate Mentoring Program, which brings students from underrepresented groups to our annual meeting and introduces them to career opportunities in wetland professions. During those 11 years we have mentored 90 students from 56 different universities. We are now in the fifth year of a collaborative initiative with the Ecological Society of America's renowned SEEDS Program. We send two participants from our program to the SEEDS Leadership Workshop each spring. For the past four years, we have brought our participants in the Leadership Workshop back to our annual meeting to lead a workshop and serve as peer mentors. This year's peer mentors were Anita Arenas (Cal State Long Beach) and Mitch Hinton (UC Davis). As a participant in last year's SWS meeting in Duluth, MN, Anita won the best student poster award.

We supported 11 students at the Joint Aquatic Sciences Meeting in Portland, OR in May. Sponsors included the National Science Foundation and several SWS Chapters (Mid-Atlantic, South Atlantic, South Central, North Central, Western, and Pacific Northwest). The 2014 award winners are:

- Kyra Barboza (Cal State Long Beach) – Western Chapter award
- Philip Bellamy (Bethune-Cookman University)
- Christin Carter (Old Dominion University) – South Atlantic Chapter award
- Mia Dawson (Oberlin College)
- Randi Jackson (University of Maine)
- Khem Marriott (Pace University)
- Maite Martin (University of Texas El Paso) – South Central Chapter award
- Nemesis Ortiz (University of Puerto Rico)
- Julio Pachon (Cornell University) – Pacific Northwest Chapter award
- Keith Perkins (Southern University)
- Elizabeth Preza (University of Texas El Paso)

Vanessa Lougheed (University of Texas at El Paso) (vlougheed@utep.edu) will be taking over as director of the mentoring program. Please think about getting involved with the program and contact Ralph Garono (SWS Diversity Committee Chair) or Vanessa if you have questions or want to join us as mentors, workshop participants, or in some other capacity.■

1. fday@odu.edu

The Wetland Treasures Initiative: Showcasing the Nation's Most Precious Wetland Ecosystems

by Abbey Tyrna and Bill Morgante[1]

The SWS Education and Outreach Committee (EOC) has created the Wetland Treasures Initiative (WTI) - the first-ever "one-stop shop" for information on high functioning wetlands in the United States. The main component of the WTI is an online showcase of top-tier wetlands to promote awareness, appreciation, and knowledge of some of the country's most ecologically sensitive landscapes. This showcase will be shared with the public via a web-based interactive map that contains scientifically based information on each treasure's ecology, biology, and geography. Intrinsic to the initiative is the significant role wetlands play in enhancing human and ecological health. Only those wetlands that provide ecological services above-and-beyond other wetlands in its class will be deemed a "Wetland Treasure." As a result, the initiative will assist SWS in realizing its vision to help "form the basis of the public's understanding of the important functions and values of wetlands."

The Wetland Treasures Initiative (WTI) is the first-ever "one-stop shop" for information on high functioning wetlands in the United States.

The WTI is modeled after the Wisconsin Wetlands Association's (WWA) Wetland Gems ™ Program. The EOC has consulted with experts including executives from WWA, wetland professionals, SWS leadership, and distinguished wetland scientists, to build a strong and sustainable foundation. Together with this field of experts, the EOC has drafted the criteria on what qualifies as a Wetland Treasure, created the conceptual model for organizing and implementing the initiative, and has secured funding for website development.

Members of the EOC are firm believers in adaptive management and, as such, consider the Wetland Treasures' criteria to be a living document that will undergo changes as the initiative is implemented. The WTI will be rolled out in two stages. During the first stage, Wetland Treasure applications will be solicited from state natural resource agencies and natural heritage programs in an effort to get their list of extraordinary

wetlands. Through this process the criteria will be tightened to ensure that the requirements mirror what state agencies have already acknowledged as wetland treasures. The second part of the rollout will be a public launch seeking applications from SWS membership and the public for other potential candidate wetlands. The EOC is gearing up for beta phase rollout in early 2015 followed by the public launch in 2016.

What's next for the Wetland Treasures Initiative? The EOC is seeking wetland experts and enthusiasts to volunteer with their regional chapters to become a part of the first Wetland Treasures Application Review Team. Reviewers will be on the same volunteer cycle as their regional chapter officers. To find out more contact WetlandTreasures@gmail.com.■

1. SWS Education and Outreach Committee

SWS Establishes Ad-hoc Committee to Investigate Uses of Floristic Quality Analysis in Wetlands and Related Ecosystems

Doug DeBerry from the College of William and Mary will lead an ad hoc committee to review and summarize the current uses of Floristic Quality Analysis (FQA) in wetlands and related ecosystems. FQA is a method that was developed in the Midwest for evaluating ecological integrity using vegetation. Within the past decade or more, the approach has gained in popularity and is currently being used in various regions throughout North America as well as overseas. The output for FQA is a "Floristic Quality Index" (FQI), a unitless value that provides a relative scale to index properties such as "quality", "conservatism", and "naturalness" - aspects of ecosystems that are typically difficult to quantify. The committee will provide an overview of FQA to answer questions such as: Who is using it? How is it being used? What are the benefits? Are there problems or concerns? The result of this research will be reported in Wetland Science and Practice, with a publication goal of Winter 2015. Questions or inquiries may be directed to Dr. DeBerry at dadeberry@wm.edu.■

Wetland Restoration Symposium speakers from the afternoon talks (left to right): Michelle Balmer, Sarah Kidd, William Glamore, Jeroen van Zuidam and Sarah Skigen. (Nate Hough-Snee photo)

Wetland Restoration Section Symposium Held in Portland

by Andy Herb and Nate Hough-Snee

One of the main goals of the Society of Wetland Scientists' Wetland Restoration Section, the Society's newest (formed in 2013) and now largest (302 members as of July 2014) special interest section, is to encourage the sharing of information between the applied, academic, and regulatory wetland sectors. In this context, wetland restoration is defined in the broadest sense, including "wetland reclamation, rehabilitation, and mitigation." A major component in meeting this goal involves the Section hosting a wetland restoration symposium at every annual SWS conference. This symposium serves as an opportunity for information transfer between different geographic regions, organizations, and sectors of wetland science. This year's meeting occurred as a part of the larger Joint Aquatic Sciences Meeting in Portland, Oregon and it was the Section's second hosted symposium.

This year's symposium "Wetland Restoration: Delivering Multiple Benefits and Recreating Lost Services" included 14 speakers and six posters from across four continents. The symposium very well attended with approximately 100 people present for nearly the entire session—standing room only! The talks ranged from the innovative designs associated with experimental fen replacement in the oil sands region of Canada to the low-cost and low-impact approach of assisted beaver dam construction to aggrade incised streams and create riparian wetlands in Oregon, USA. Other topics included a cost-effective and simple approach to restoring wetlands for selenium removal at a mine site in the western US; a great example of adaptive management to remove debris and reduce goose herbivory on a tidal marsh site in New Jersey, USA; and a creative approach to water quality improvement and peatland restoration in the Netherlands using constructed floating mats of vegetation.

We thank all of this year's participants for contributing to the symposium and hope that interested parties will get in touch with Andy Herb if they have an interest in being a part of future symposia. ■

A list of presenters and abstracts are available on the Wetland Restoration section page of sws.org.

Some of the Wetland Restoration Section Speakers (rear, from left to right) Steve Carpenedo, Heida Diefenderfer, Bianca Pier, Christine Daly, Beverly Julienne Morissette, Steve Bennett, and Nick Bouwes; and session co-chair Nate Hough-Snee (front). (Andy Herb photo)

Applied and Research Sectors Gather at Rocky Mountain Chapter Meeting

by Andy Herb[1]

I remember engaging in SWS back in the 1990s when I first started my career as an ecologist. I didn't think much of it, I just signed up to be a member because it was the only organization I knew about that was focused on wetlands. It took a few years for me to want more from the Society. Around 2001, I started to get comfortable enough in my consulting career that I wanted more interaction with other wetland professionals. I asked a few colleagues in the Denver area to get together occasionally to discuss their projects and debate other wetland issues. After a couple years, I realized that I would like even more interaction with like-minded professionals, so I started attending the SWS International Conferences; 2005 in Charleston and 2007 in Sacramento. The conferences were (and still are) amazing. They were incredibly informative and a great place to make life-long professional connections. After attending several conferences, I realized how important sharing technical information became to my career. Since there had not been an SWS event in Denver for many years, I founded the Denver Speaker Series in 2009. I thought this would be a way to get wetland professionals (and non-professionals) in the region together more often to share ideas, and make personal and professional connections.

About 25 people attended our first event and all agreed that it was a raging success. Since then, we've held two meetings every year and this fall we held our 10th. We consistently have about 50 attendees and have had as many as 75. Each event has three speakers, and at least one focuses on a regulatory issue and one on a research topic. The intent of the Series is mainly to get people from the three main sectors of the Society—researchers, practitioners, and managers—in one room to compare notes so we can all improve the quality of our work.

I had the same vision for the 2014 Rocky Mountain Chapter Meeting and modeled the meeting after the Speaker Series. Our meeting was held on April 9 and was also a great success, with over 100 attendees. It was a perfect example of the marriage of the applied and research sectors. We had a session for each sector and there were no concurrent sessions. Thus, the audience (from both sectors) attended all the talks. Having only one session kept the participants from having to choose which talks to attend, which often results in attending talks from their own sector.

This kind of regional meeting helps the sectors of the Society improve collaboration and data sharing, which is a key role of SWS. We need to continue to improve information exchange among the sectors--in both directions--so that sound science can be more integrated into the work practitioners are doing (mainly with regard to wetland assessment and restoration) and sound applied techniques can be more integrated into science (buildability, efficiency of methods, practicability, etc). Too often, the research community is involved in work (sometimes for regulating agencies) that results in approaches to assessment and restoration that are not realistically implemented by most practitioners (who often have limited training, time, and/or money). And, too often practitioners and managers are using methods in the field that are not backed by sound science. There is a middle ground that is very effective....but sometimes elusive.

Finding that middle ground starts by getting people together at meetings like ours (and other annual SWS meetings), but we need to work harder at having symposia that are more integrated and creative so that the audiences are filled with people from both camps, and they are encouraged to interact with each other. ■

A full list of presenters and abstracts are available on the Rocky Mountain chapter page of sws.org.

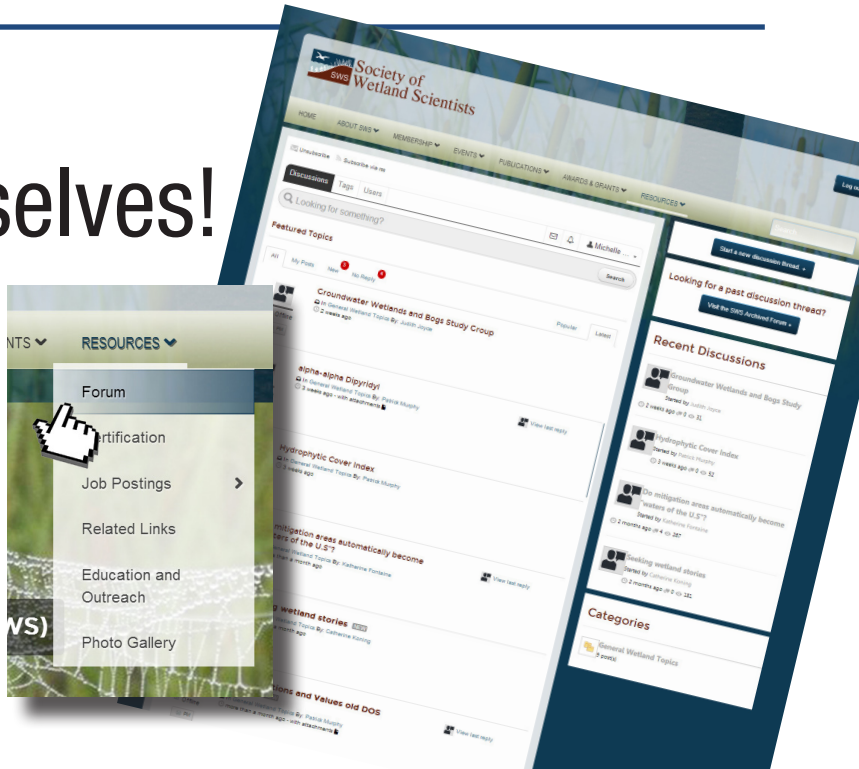
1. Alpine Ecological Resources, LLC (AlpineEco); SWS Rocky Mountain Chapter President; Founder and Chair of the SWS Wetland Restoration Section

WEB TIP

Talk amongst yourselves!

Visit the SWS Discussion Forum to start a discussion, pose a question or share interesting material with your peers. Just login as a member for full access. Then, simply click on the post you want to read and hit "reply" to provide your input or "start a new discussion thread" to start a discussion on your own.

Want regular updates? Click on the envelope in the upper left corner and select your subscription preferences. **Get started at sws.org.**



Monitoring Indicators of Climate Change along Long Island Sound: A Simple Protocol for Collecting Baseline Data on Marsh Migration

Chris S. Elphick[1] and Christopher R. Field, Department of Ecology and Evolutionary Biology and Center for Conservation and Biodiversity, University of Connecticut, Storrs, CT

The 2014 release of the Fifth Assessment Report by the Intergovernmental Panel on Climate Change makes clear that if we are to adapt to a changing climate we need a comprehensive monitoring system that will not only describe how conditions are changing, but also enable us to assess what the consequences of those changes will be. Coastal areas, in particular, warrant attention as sea-level rise and changes in storm intensity are likely to alter flooding patterns in ways that greatly affect both natural and built environments (Woodruff et al. 2013).

Coastal wetlands are likely to be among the places where the effects of climate change interact most severely with other human activities that cause environmental change. In the USA, for example, nearly 40% of the population lives in coastal areas (NOAA 2013). The Long Island Sound ecosystem – lying between Connecticut and Long Island, New York, in the north-eastern USA, with the city of New York at its western end, over 4 million people living in its coastal communities, and one of the most highly developed coastlines on the continent – is a poster child for such conditions (Tedesco et al. 2014). Coastal wetlands in this area have a long history of human modification (altered hydrology, introduced species, pollution, etc.), usually to the detriment of native species. But, there is also a long history of land protection and tidal marsh restoration in the region (Warren et al. 2002; Rozsa 2012).

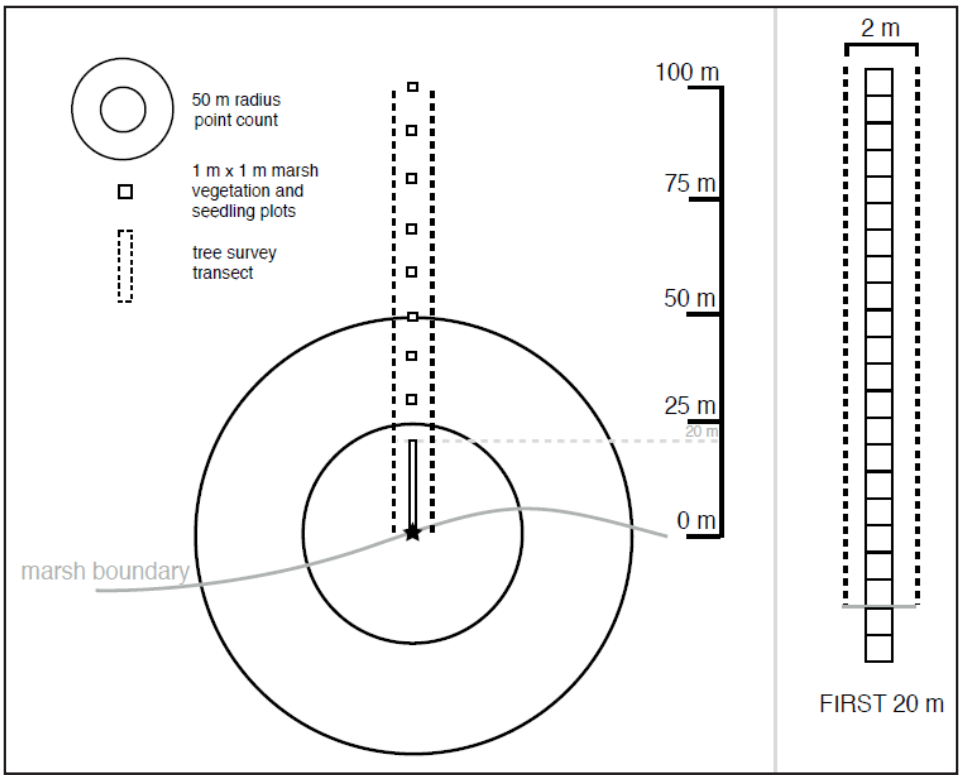


Figure 1. chematic diagram for simple transects used to create a baseline for tracking marsh migration in Long Island Sound, USA. Each transect runs for up to 100 m inland from the marsh boundary. Vegetation plots are surveyed for marsh plants in the first 20 m, at 10 m intervals thereafter, and for 2 m seaward into the marsh. Trees are surveyed within a 2 m band along the entire transect. Birds are surveyed with a 50 m radius point count centered on the marsh boundary end of the transect.

Developing a Monitoring Program for Long Island Sound

Developing a comprehensive monitoring program requires both that one assess what information is already available and what data gaps should be filled. In an ideal world, monitoring would build off existing data sets, using historical information to provide a baseline for tracking change, and this approach is a core principle of efforts to develop climate change monitoring for coastal Long Island Sound (Barrett et al. 2011). We recently compiled ecological data sets for the region's coastal wetlands to assess what information is available for key climate change "sentinels" that have been identified by the Long Island Sound Study (Barrett et al. 2011). Most existing data sets are far from ideal. In general, ecological time series are too short or incomplete to assess the past effects of climate change with confidence, although this may change in the future if sustained monitoring is put in place. Many historical data sets also lack sufficient meta-data (e.g., precise locations)

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to allow direct comparisons with contemporary data, or were not collected with sufficiently consistent (or documented) methods to draw clear conclusions. Additionally, few studies involve data collection at multiple sites, making it difficult to assess whether any trends that have been observed represent general phenomena rather than just local changes. Nonetheless, these data provide an important first step in identifying baseline conditions and provide a strong foundation around which to build a more comprehensive monitoring program.

Perhaps the biggest shortcoming of the available data is the lack of information on contemporary marsh migration. Several data sets allow one to examine vegetation change within coastal marshes, or to examine the responses of animal populations to those changes, but few data are available on conditions right at the marsh-upland boundary. Addressing this knowledge gap is especially important given that vegetation within marshes appears to be changing in a manner consistent with marshes getting wetter (Warren and Niering 1993; Donnelly and Bertness 2001; Field and Elphick, unpublished data), and the potential for both widespread loss of contemporary tidal habitats and increased marsh transgression in coming decades (Kirwan and Megonigal 2013).

With all this in mind, we developed a simple protocol to generate baseline data for long-term monitoring of marsh migration. We opted for a protocol that would be cheap and easy to replicate, allowing us to generate a high level of spatial replication and to increase the ease with which repeat surveys would be possible in the future. Consequently, we decided that we could not collect data on all variables of potential interest; that our methods should not require expensive, specialized equipment; and that the methods should not require considerable specialized knowledge but be simple enough for field technicians to learn with just a few days of training. These constraints further required that we could not conduct complete species inventories or collect much of the information that would be needed to fully understand the mechanisms behind change.

We settled on a plan that focused on three questions: (1) is the marsh moving inland, which we determined by measuring how far saltmarsh plants encroach terrestrial habitat; (2) are terrestrial plants being affected by saltwater encroachment, which we assessed by documenting evidence for elevated tree mortality at the marsh edge; and (3) is the fauna changing, which we quantified by describing the bird community.

Establishing the Baseline

First, to test whether marshes are actually migrating, we created transects that run inland from the marsh-upland boundary (Figure 1). We operationally pinpointed the boundary as the seaward frontier of the upland vegetation, providing field technicians with a list of saltmarsh species and defining any other plants as being part of the upland vegetation. After precisely georeferencing a transect's start location, we ran a line inland and perpendicular to the marsh edge and examined the vegetation within each meter-square for the first 20 m and for 2 additional meters in the direction of the marsh. Within each quadrat along a transect, we recorded the presence or absence of a pre-defined list of the major saltmarsh and marsh-boundary species characteristic of the region. After 20 m, we continued the transect inland, with additional quadrats at 10 m intervals

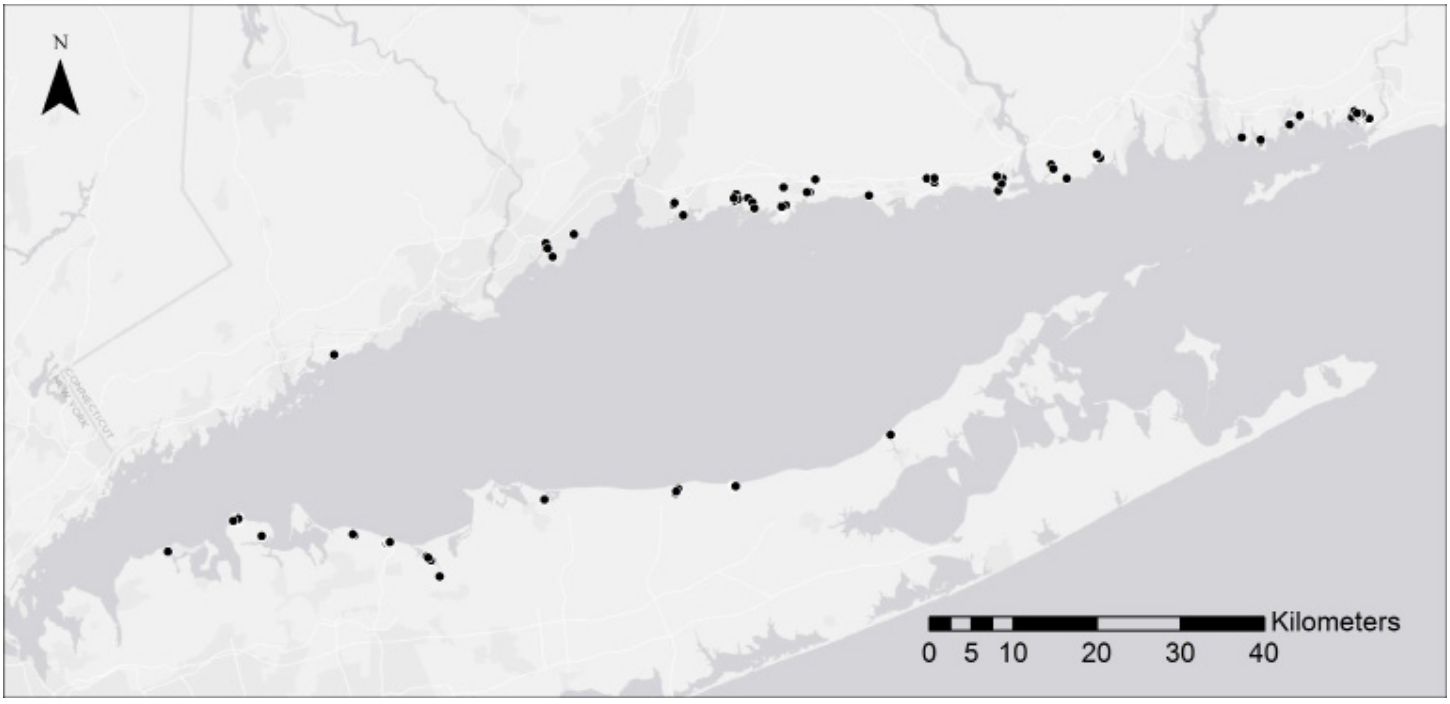

Figure 2. Distribution of 170 marsh migration sampling locations around Long Island Sound, USA. At each site we have collected baseline data on marsh vegetation encroachment into the uplands, tree mortality, and bird species occurrence.

for up to 100 m. To simplify the design, we did not attempt exhaustive vegetation surveys, nor did we attempt to quantify the abundance of each species.

To determine whether saltmarsh encroachment is affecting upland vegetation, we recorded all trees within 1 m of the transect lines that we created to assess the transgression of marsh vegetation into the uplands. For each tree, we determined the species, whether it was alive, what proportion of the crown showed evidence of dieback, the diameter at breast height, and whether there was any direct evidence for the cause of death or damage (e.g., Hurricane Sandy). Finally, to assess whether there are effects on wildlife we conducted a 50 m radius avian point count at the start point of each transect to document the bird species present right at the marsh-upland boundary. Copies of all of our field protocols are available at http://elphick.lab.uconn.edu/ and http://www.tidalmarshbirds.org/.

During the summer of 2013, we implemented this protocol at 170 sites around the coast of Long Island Sound (Figure 2). To ensure that our sampling is representative of the entire coastline, we selected sites randomly from locations where marsh migration is projected to occur based on topography and sea-level rise projections. This protocol cannot tell us with confidence what change has already occurred, although better information on the presence of saltmarsh plants in the forest understory and on tree mortality rates at the forest edge do provide insight into the transgression process. More important is that the creation of this baseline data set will allow comparisons in decades to come. Moreover, the basic protocol is easily repeatable and can be extended to other regions with little modification.

Expanding the Study Area

This summer, we are expanding our sampling beyond the Long Island Sound coast, and our hope is that, in future years, we – or others – will expand the sampling into other coastal areas in order to lay the groundwork to better document the ways in which the coastline is changing in response to altered tidal flooding patterns.

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President's Message continued from page 3

sentatives from the New England chapter and our venue is perfectly designed to let us explore the wetland science of global climate change. There are a number of field trips lined up to New England barrier islands, bogs, coastal marshes, and restored wetland sites. Plenary speakers from around the globe will be joining us. This is going to be an exciting meeting, so I hope that you can join us there!

In the meantime, the Future Meeting group is busy at work. The South Central chapter has provided a successful bid for the 2016 meetings and it will be held in Corpus Christi, Texas. They are currently looking for a 2017 venue. One question that we are asking, and would like our member's feedback on, is how often should we schedule international meetings? Do international meetings eliminate many of our core members because of costs? Could we hold international meetings closer to home, such as Mexico or Canada?

Finally, please remember that this organization exists because of you, its members. It is important not only that you are kept informed, but also that you are enabled to take part in the processes of defining what is important to SWS. Please let us know if there is something that you feel we can we could do to make our society stronger or more meaningful. My email is open to you (but beware my spelling – it's atrocious!).

Stay Cool! ■

An Approach to Monitoring Coastal Marsh Migration in the Northeast

Ralph W. Tiner[1], U.S. Fish and Wildlife Service, Northeast Region, Hadley, MA and Peter M. Veneman[2], University of Massachusetts, Department of Plant, Soil, and Insect Sciences, Amherst, MA

Global climate change has significant implications for ecosystems worldwide. An increase in sea-level is one of its many environmental impacts. Melting of Arctic and Antarctic ice and thermal expansion of ocean water are causing sea levels to rise at rates higher than in the past century (http://www.ipcc.ch/publications_and_data/ar4/wg1/en/faq-5-1.html). This rise is affecting vegetation in low-lying areas along most coasts (i.e., subsiding coasts; Figure 1).

Changes in coastal vegetation attributed to rising seas is not a new phenomena as scientists have reported finding remains of trees in salt marshes and underwater in the mid-1800s and early 1900s (Dawson 1856; Mudge 1862; Ganong 1903; Bartlett 1911; Harshberger and Burns 1919). "Marine transgression" has occurred on coastal lands since the last glaciation as sea level initially rose rapidly with the melting of continental glacial ice (see Tiner 2013 for overview). Land on the former coastal plain was submerged and forms the sea floor of what is now called the continental shelf. Around 5-6,000 years ago, glacial ice melting virtually ceased and the rate of sea-level rise (SLR) slowed to 15-30 cm per century (Gornitz 2007). This allowed for the formation of estuaries, barrier islands and coastal marshes in near present-day locations. As sea level continued to rise, lowland forests became flooded sufficiently with salt water to kill the woody plants and provide suitable substrate for colonization by marsh plants - the marshes were "migrating" inland. "Marsh migration" continues to occur as long as sea level rises and there is land available at suitable elevations to support the growth and reproduction of halophytic vegetation (e.g., Carey 1996; Donnelly and Bertness 2001; Tiner 2013). Vegetation changes also occur within the salt marshes. For example, low marshes become tidal flats or open water, while the high marsh is transformed to low marsh. Neighboring low-lying forests are eventually converted to salt marsh as those areas are exposed to frequent tidal flooding with salt water (Figure 2). Halophytic vegetation may also "migrate" upstream in coastal rivers as salinity moves further upstream. The entire zone from salt to fresh tidal may shift accordingly over time. While this is a natural process, the increased recent rate of sea-level rise is causing these changes to occur at a faster pace.

Much of the research addressing the effect of climate change on salt marshes is dedicated to studying coastal processes in the marshes themselves, such as erosion, accretion, and subsidence (e.g., Cahoon et al. 2002; Lane et al. 2006). Little if any attention has been given to salt marsh migration. Many National Wildlife Refuges are situated along the U.S. coastline and will experience changes in

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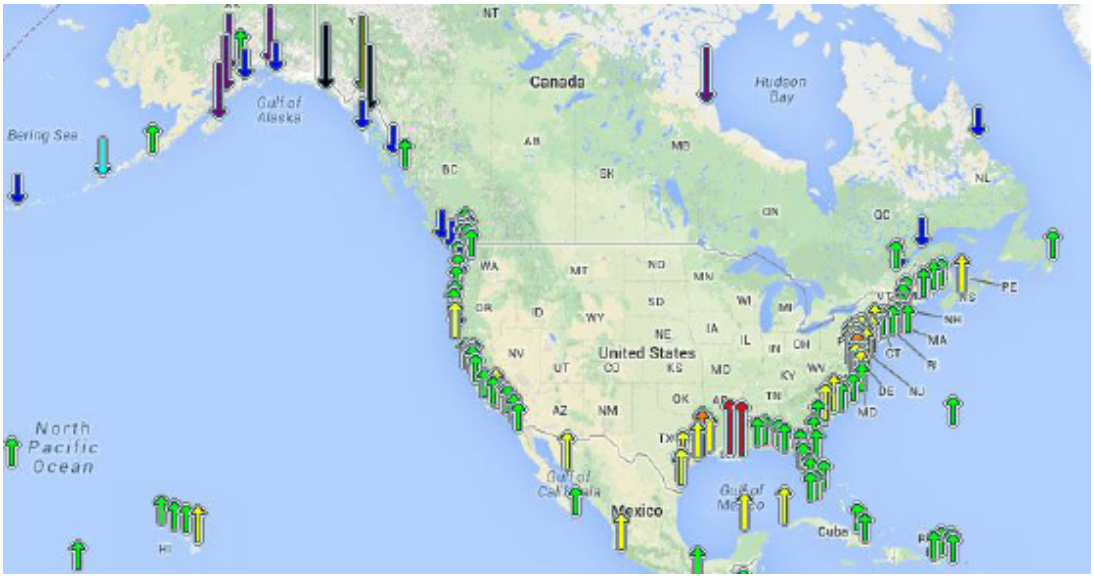

Figure 1. Current rates of sea-level rise in North America. The upward pointing arrows indicate rising sea level (green – lower, yellow – higher, and red – highest rate) while the downward ones represent negative sea level rise resulting from tectonic activity and/or post-glacial rebound. (http://tidesandcurrents.noaa.gov/sltrends/)

plant communities with rising sea level. Establishing a few plots at these refuges would require a minimum investment of time, but would yield interesting results for understanding the nature of vegetation change. Since the refuge program is engaged in long-term planning, we decided to work with refuge personnel to establish a baseline for monitoring changes in coastal vegetation, namely to document coastal marsh migration. This project involves establishing permanent plots in several National Wildlife Refuges and neighboring conservation lands where salt marsh migration (i.e., changes from forest to marsh) is occurring or is expected to occur due to their low topographic relief. At a minimum, the effort will document changes in local vegetation patterns and soil properties due to sea-level rise. From this information if collected at enough varied locations, we can learn how rapid or slow such changes are occurring and how such changes differ geographically. The work can be coupled with periodic aerial image analysis to document large-scale changes on the refuges and surrounding areas (e.g., deterioration of the high marsh as evidenced by the formation of pools and pans), or with research studies of marsh processes.

Figure 2. An example of coastal marsh migration: dead trees in a Maine salt marsh.

Study Approach

The project represents an effort to initiate a long-term monitoring program for documenting changes in vegetation and soil properties related to rising sea level. Permanent plots are established to record baseline conditions of vegetation and soils. Follow-up investigations can be performed at periodic intervals to monitor change. To date, permanent plots have been established in the Northeast Region at four National Wildlife Refuges and other conservation areas in New Jersey, New Hampshire, and Maine (Table 1).

The emphasis of current projects is largely on documenting migration of salt marsh into contiguous lowland forest. Since rising sea levels will also allow halophytic species to colonize areas further upstream in coastal rivers due to increasing salinities, some plots have been established in brackish marshes where signs of stress have been observed in neighboring forests especially Atlantic white cedar swamps (*Chamaecyparis thyoides*).

Methodology

For each study area, permanent plots will be established along a general "transect" extending from the high salt marsh into the contiguous lowland forest (wetland and/or upland). The "transect" does not necessarily follow an exact straight line but typically follows a narrow swath intersecting a variety of plant communities along a topographic gradient from the marsh into the forest. Each study area will, at a minimum, contain vegetation plots in the high marsh and forest. Additional plots may be located in different zones of the salt marsh where desirable. The number of communities analyzed will vary per site. Some forest plots will only be positioned in neighboring freshwater wetlands where such wetlands are extensive, while other areas will include low-lying upland forests. In the future, additional plots can be identified further inland as necessary.

The size of the plot will vary according to the predominant vegetation. For herbaceous communities (marshes, meadows, and fields), one 1.52-m radius circular plot is established at each sample point. For shrub communities, one 4.57-m radius plot is used. Salt marsh shrubs are included in the 1.52-m radius plot. Forest vegetation is evaluated within a 9.14-m radius or 4.57-m radius circular plot depending on tree density (i.e., smaller plot for high density of trees) or time available. Within the forest plot, herbs are analyzed in a 1.52-m radius plot while shrubs are evaluated within a 4.57-m radius plot. The center of each circular plot is marked with a wooden stake except in forests where a tree is typically used to mark the plot center. Plot coordinates are recorded using a GPS.

Sampling Parameters

Vegetation is sampled by plot analysis and soil samples are evaluated in the field. Optional sampling could include the point-intercept method, whereas soil samples could be analyzed in a soil lab for texture, bulk density, and percent organic carbon. Marsh accretion could be evaluated by applying colored soil (e.g., feldspar) to the surface and interstitial salinity could also be measured.

Vegetation Analysis. Three life forms are evaluated: graminoid/herb, shrub/sapling, and tree, while climbing woody vines may or may not be sampled. The graminoid/

Table 1. Specific location of study plots. FB – Furbish Road, LR – Little River, DC – Discovery Center, WP – Woodman Point, CSC – Cedar Swamp Creek, DH – Del Haven, DeC – Dennis Creek, RB – Old Robbins Brook, ATT – AT&T, JC – Jobs Creek, and LT – Leeds Point.

Study Area (State)	Plot #	Latitude	Longitude	Dominant Species
Carson NWR (ME)	FB1	43° 16' 53.53"N	70° 35' 08.15"W	*Pinus strobus-Acer rubrum* (upland)
	FB2	43° 16' 52.63"N	70° 35' 06.91"W	*A. rubrum* (wetland)
	FB3	43° 16' 52.06"N	70° 35' 05.70"W	*Morella pensylvanica*- graminoids (former swamp forest)
	FB4	43° 16' 51.77"N	70° 35' 04.99"W	*Spartina pectinata-Panicum virgatum*
	FB5	43° 16' 51.14"N	70° 35' 03.64"W	*Salicornia maritima-Triglochin maritima*
	FB6	43° 16' 50.75"N	70° 35' 02.83"W	*Spartina patens-Spartina alterniflora*
	FB7	43° 16' 50.34"N	70° 35' 01.95"W	*S. patens-Glaux maritima*
	FB8	43° 16' 50.15"N	70° 35' 01.50"W	*G. maritima-Juncus gerardii*
	LR1	43° 20' 47.30"N	70° 32' 24.69"W	*Picea mariana-A. rubrum* (swamp)
	LR2	43° 20' 46.79"N	70° 32' 25.16"W	*Pinus strobus-P. mariana*
	LR3	43° 20' 46.27"N	70° 32' 25.71"W	*Gaylussacia baccata-Vaccinium corymbosum* (former maple swamp)
	LR4	43° 20' 45.65"N	70° 32' 26.22"W	*Calamagrostis canadensis-Symphotrichum novi-belgii*
	LR5	43° 20' 45.11"N	70° 32' 26.64"W	*S. pectinata*
	LR6	43° 20' 44.47"N	70° 32' 27.18"W	*S. patens*
	LR7	43° 20' 44.02"N	70° 32' 27.52"W	*S. patens*
	LR8	43° 20' 43.70"N	70° 32' 27.79"W	*S. patens* (top of creekbank)
Discovery Ctr (NH)	DC1	43° 03' 22.14"N	70° 53' 50.74"W	*Spartina alterniflora* (low marsh)
	DC2	43° 03' 21.24"N	70° 53' 58.86"W	*Salicornia-S. alterniflora-Schoenoplectus robustus*
	DC2.5	43° 03' 20.58"N	70° 53' 58.92"W	*S. patens*
	DC3	43° 03' 20.10"N	70° 53' 59.10"W	*Juncus gerardii*
	DC4	43° 03' 19.62"N	70° 53' 59.10"W	*Iva frutescens-S. patens*
	DC5	43° 03' 19.20"N	70° 53' 59.10"W	*Phragmites australis* (native)-mixed forbs
	DC5.5	43° 03' 18.88"N	70° 53' 59.23"W	Dying Palustrine Forest-*P. australis* (wetland)
	DC6	43° 03' 18.48"N	70° 53' 58.86"W	*Quercus rubra* (upland)
Great Bay NWR (NH)	WP1	43° 04' 25.10"N	70° 51' 22.39"W	*S. alterniflora* (tall; low marsh)
	WP2	43° 04' 25.72"N	70° 51' 22.72"W	*Distichlis spicata-S. patens*
	WP3	43° 04' 26.29"N	70° 51' 22.82"W	*S. alterniflora* (short/intermediate)- *S. patens*
	WP4	43° 04' 27.52"N	70° 51' 23.16"W	*S. patens*
	WP5	43° 04' 27.91"N	70° 51' 23.18"W	*D. spicata*-mixed
	WP6	43° 04' 28.24"N	70° 51' 23.40"W	*S. pectinata-Typha latifolia*
	WP7	43° 04' 28.99"N	70° 51' 23.11"W	*Fraxinus pennsylvanica* (wetland)
	WP8	43° 04' 29.86"N	70° 51' 23.36"W	*F. pennsylvanica* (wetland)
	WP9	43° 04' 30.14"N	70° 51' 23.26"W	*Ostrya virginiana*-mixed hardwoods (upland)
Cape May NWR and vicinity (NJ)	CSC1	39° 14' 32.39"N	74° 43' 43.87"W	*Typha angustifolia* (brackish marsh)
	CSC2	39° 14' 22.11"N	74° 43' 45.28"W	*P. australis* (non-native)
	CSC3	39° 14' 39.91"N	74° 43' 46.58"W	*Morella pensylvanica-Smilax rotundifolia*
	CSC4	39° 14' 32.11"N	74° 43' 32.11"W	*A. rubrum* (wetland)
	DH1	39° 02' 54.59"N	74° 54' 54.59"W	*P. australis* (non-native w/standing dead trees)
	DH2	39° 02' 54.46"N	74° 54' 54.46"W	*Ilex opaca-Chasmanthium-P. australis* (dying upland forest)
	DH3	39° 02' 53.68"N	74° 54' 53.68"W	*A. rubrum-Quercus phellos* (dying upland forest)
	DH4	39° 02' 53.30"N	74° 54' 49.90"W	*Liquidambar styraciflua-A. rubrum-Quercus* (swamp)
	DeC1	39° 11' 21.99"N	74° 48' 21.99"W	*Morella cerifera-A. rubrum* (former cedar swamp)
	DeC2	39° 11' 23.39"N	74° 48' 23.39"W	*Chamaecyparis thyoides* (stressed)
	DeC3	39° 11' 26.99"N	74° 48' 26.99"W	*C. thyoides* (healthy)
	RB1	39° 11' 48.40"N	74° 52' 08.60"W	*C. thyoides* (stressed)
	RB2	39° 11' 57.90"N	74° 52' 00.50"W	*C. thyoides* (healthy)
Forsythe NWR (NJ)*	ATT1	39° 41' 54.18"N	74° 13' 18.41"W	*A. rubrum-Sassafras albidum-Pinus rigida-I. opaca* (upland)
	ATT2	39° 41' 55.98"N	74° 13' 13.74"W	*A. rubrum-L. styraciflua-I. opaca* (wetland)
	ATT3	39° 41' 56.55"N	74° 13' 11.60"W	*A. rubrum*
	ATT4	39° 41' 56.51"N	74° 13' 10.42"W	*Nyssa sylvatica-A. rubrum*
	ATT5	39° 41' 58.44"N	74° 13' 08.45"W	*P. australis* (non-native)-*Pluchea purpurascens*
	ATT6	39° 41' 58.83"N	74° 13' 0.53"W	*S. patens*
	ATT7	39° 41' 59.80"N	74° 13' 02.94"W	*S. patens*
	ATT8	39° 41' 59.93"N	74° 13' 03.10"W	*S. patens-D. spicata*
	JC1	39° 35' 08.35"N	74° 25' 13.17"W	*C. thyoides* (healthy)
	JC2	39° 35' 08.86"N	74° 25' 14.69"W	*A. rubrum* (former cedar swamp)
	JC3	39° 35' 09.08"N	74° 25' 15.25"W	*P. australis* (non-native)-*Schoenoplectus americanus-T. radicans*
	JC4	39° 35' 9.56"N	74° 25' 15.73"W	*S. americanus-P. australis-Toxicodendron radicans*
	JC5	39° 35' 14.01"N	74° 25' 16.13"W	*S. americanus*
	JC6*	39° 35' 14.74"N	74° 25' 15.91"W	*N. sylvatica-M. pensylvanica-V. corymbosum* (wetland)
	JC7*	39° 35' 15.32"N	74° 25' 15.33"W	*Quercus-N. sylvatica-Gaylussacia frondosa* (upland)
	LP1	39° 29' 48.69"N	74° 25' 40.13"W	*S. patens*
	LP2	39° 29' 48.04"N	74° 25' 39.98"W	*P. virgatum-S. americanus*
	LP3	39° 29' 47.60"N	74° 25' 39.87"W	*N. sylvatica-P. rigida*
	LP4	39° 29' 45.78"N	74° 25' 39.44"W	*Quercus* spp. (wetland)
	LP5	39° 29' 45.08"N	74° 25' 40.05"W	*Quercus alba* (upland)

*Plot locations for these plots were not recorded initially but will be GPSed later this year during the 5-year review; their locations are approximate.

herb stratum is represented by nonwoody plants but also include trailing woody plants less than 1 m tall (e.g., *Toxicodendron radicans* and *Parthenocissus quinquefolia*) and seedlings of woody plants less than that height. The shrub/sapling stratum is comprised of woody plants less than 6.6 m tall, while the tree stratum is made up of woody plants 6.6 m or taller.

Metrics. Cover is estimated for all species even unknowns, while density and diameter at breast height are additional metrics for trees. For marsh plots, the % areal cover of bare ground in the 1.52-m circular plot is also estimated when it represents 10% or more of the plot. Woody vines are noted but since estimates of cover are often difficult, they will not be evaluated for cover. Alternatively, a stem count of woody vines growing on trees and shrubs can be made.

The "condition" of the canopy of woody plants is assessed as follows: *excellent* – no sign of die-back or stress; *good* – no sign of die-back but some stress noted (e.g., chlorosis); *fair* – some sign of die-back (up to 25% dieback of canopy); *somewhat poor* – significant die-back (25-50% dieback); *poor* (>50% to 90% dieback); *extremely poor* (>90% dieback, very little live woody material). The number and types of species stressed, dying, or dead trees will also be recorded. Signs of stress include wilting leaves, reduced growth, chlorophyll deficiency (chlorosis - yellowing of leaves), dying parts, dead parts, and possibly lack of "normal" twig growth.

Soil Analysis. For all communities, a soil sample will be taken within each plot. Soil properties will typically be described to a depth of 40 cm following standard soil classification techniques (soil colors and texture by feel).

Monitoring

Monitoring is to be performed at 5-year intervals, and possibly during the growing season in the year following a major disturbance event (e.g., hurricane). This work only involves one- or two days of field work depending on the number of plots per study area. In the short-term, monitoring will likely be done by the principal investigator and cooperators and beyond that by cooperators and/or students from local universities. Ideally the monitoring program will be part of the routine management and planning efforts of the refuge or other conservation area.

Future Work

This fall will be the first monitoring evaluation for the Forsythe NWR sites for which baseline data were collected in 2009. Plans are underway to establish plots at Chincoteague NWR (Virginia) and the State of Connecticut's Barn Island Wildlife Management Area. Agencies/organizations interested in tidal wetlands are encouraged to consider establishing permanent plots at other conservation areas.

Summary

With minimal time and effort, a network of sentinel sites can be created to track changes in coastal vegetation over time. The work can also be coupled with remote sensing studies to document significant areal changes in vegetation patterns (e.g., forest to mixed marsh/forest to salt marsh and high marsh to low marsh to tidal flat) on the entire refuge/reserve and perhaps in neighboring areas as well. This monitoring effort complements research being conducted in the salt marshes that attempt to better understand how the marshes are responding internally to changes in sea level.

Acknowledgments

This work is being done with assistance and cooperation from others. Participants have included Kevin Holcomb, Heidi Hanlon, Nancy Pau, Susan Adamowicz, David Tibbetts, Ward Feurt, Sierra Kuhn, Melissa Guevara, Megan Zopfi, Nick Ernst, and Kaytee Hojnacki (U.S. Fish and Wildlife Service), Joe Smith, Dale Schweitzer, and Joanne Glode (The Nature Conservancy), Rachel Stevens and Paul Stacey (Great Bay National Estuarine Research Reserve), Tin Smith (Wells National Estuarine Research Reserve), Katie Callahan (New Hampshire Fish and Game), and Adrienne Kovach (University of New Hampshire).

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Recent Trends in U.S. Prairie Pothole Wetlands

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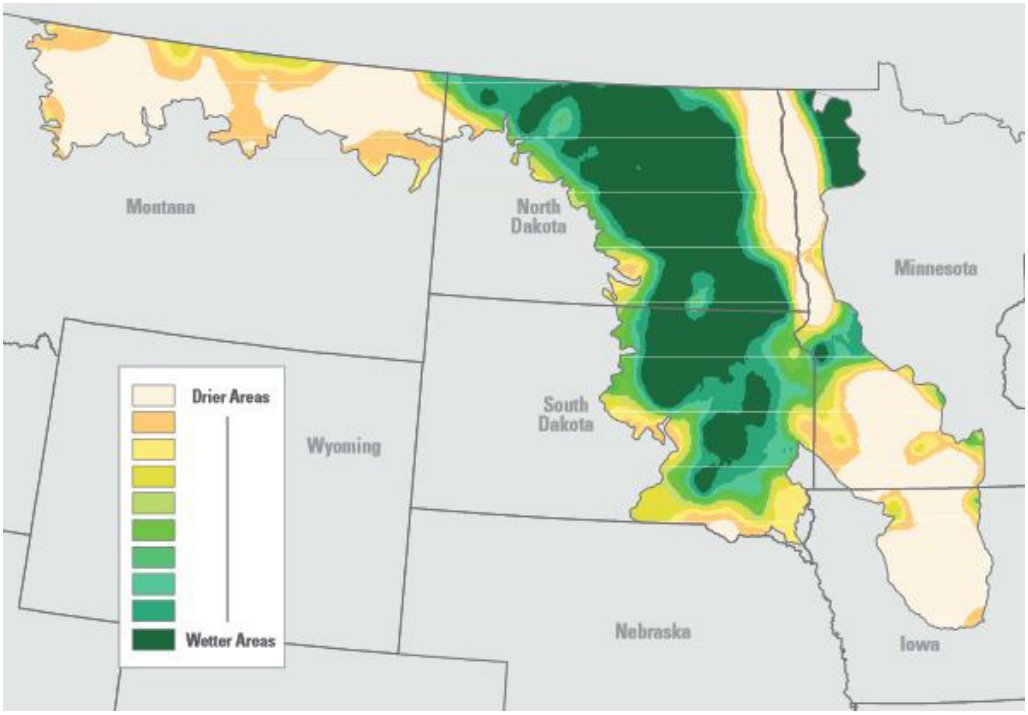

Figure 1. Location of the Prairie Pothole Region in the United States showing differences in wetness across the region. Wetter areas support the highest density of wetlands - more than 100 basins per square mile in places.

The U.S. Fish and Wildlife Service (USFWS) is the principal Federal agency that provides information to the public on the extent and status of the Nation's wetlands. The most recent report released in July of 2014 presents the latest status information on the extent, type and trends of wetland resources in the Prairie Pothole Region (PPR) of the United States and provides estimates of losses or gains that occurred between 1997 and 2009.

The PPR in the U.S. encompasses an area of about 150,930 square miles and extends from central Iowa north to the Canadian border and includes portions of the states of Iowa, Minnesota, North Dakota, South Dakota and Montana (Figure 1). The region is characterized by numerous small landscape depressions left behind as the glaciers receded from this part of the continent. These landscape depressions, termed "potholes", collect rainfall and snowmelt forming small shallow wetlands and ponds (Figure 2).

During the past century, prairie wetlands were extensively drained and in some areas only isolated tracts of wetland habitat remain. Drainage for agriculture during the years preceding the 1980s was pervasive as tile and open-ditch drains eliminated large numbers of wetland basins and converted lands to crop production.

For this study changes in wetland area were measured by the examination of high resolution imagery for 755 randomly selected sample plots covering the PPR. The analysis of this imagery in combination with field verification provided a scientific basis for estimations of wetland extent, type and distribution that had occurred between 1997 and 2009. Important procedural enhancements to this study of the PPR included the addition of wetland and water basin morphology, hydrologic descriptors and the addition of an upland grassland category to track changes in grassland area.

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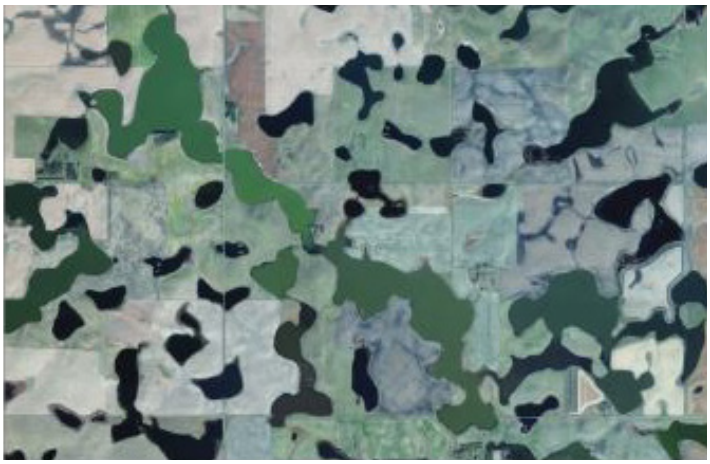

Figure 2. Aerial view of pothole wetlands in Day County, South Dakota (2010).

1. mitch_bergeson@fws.gov The findings and conclusions in this article are those of the author and do not necessarily represent the views of the U.S. Fish and Wildlife Service.

This section is intended to inform readers about ongoing wetland research by various universities, government agencies, NGOs and others. When studies are completed, WSP invites short articles that address key findings, while more technical papers are submitted to Wetlands or other peer-reviewed journals. Researchers interested in posting short or more detailed summaries of their investigations are encouraged to contact the WSP editor (please include "WSP Research News" in the email subject box).

This issue highlights graduate research at the ***Department of Environmental Science and Biology, The College at Brockport, State University of New York, Brockport, New York****. Special thanks to Doug Wilcox for coordinating this contribution. Also see monthly issues of Wetland Breaking News for news clips on wetland research (http://www.aswm.org/news/wetland-breaking-news/892-current-issue#science).*

Water chestnut: germination, competition, seed viability, and competition in Lake Ontario

Objectives:

1. Determine germination rate of invasive, exotic water chestnut (Trapa natans) under varying light and temperature.
2. Analyze intraspecific and interspecific competition between water chestnut and white water lily (Nymphaea odorata).
3. Find and monitor water chestnut patches throughout Braddock Bay.
4. Determine the viability of water chestnut seeds in different stages of development.
5. Inventory known occurrences of water chestnut in Lake Ontario wetlands.

Expected completion: May 2015

Contacts: Kathryn Des Jardin (kdesj1@brockport.edu) and Dr. Douglas A. Wilcox (dwilcox@brockport.edu)

Predicting potential effects of climate changes on WRP wetland restoration projects in Genesee County, New York

Objectives:

1. Identify USDA NRCS WRP wetland sites that are potentially sensitive to predicted changes in climate and therefore likely to be reduced in size or altered in function or value from the original goal of the restoration, thus allowing adaptive management procedures to be applied.
2. Conduct hydrological assessments using a water budget approach to determine main water sources and identify sites at risk.
3. Map plant communities and sample vegetation quantitatively to assess vegetative indicators of water sources.
4. Collect specific conductance, temperature, and pH water chemistry data to identify different sources of water.
5. Record observations of muskrat activity to provide additional biological indicators of water- level changes.

Expected completion: May 2015

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The Effects of a Marcellus Shale Gas Drilling Accident on Wallace Mine Fen in the Moshannon State Forest, Pennsylvania

Objectives:

1. Determine if surface and subsurface hydraulic fracturing accidents at gas well on private land have impacted Wallace Mine Fen (WMF) in Moshannon State Forest, PA.
2. Collected tree core samples from five trees at WMF and analyzed using Gas Chromatography Mass Spectrometry to detect contamination within trees.
3. Conducted amphibian surveys (nocturnal auditory surveys and visual encounter surveys) at WMF and a control site, Crystal Spring Bog (CSB, which is actually a fen) to determine any differences in amphibian populations.
4. Conducted bird point-count surveys in WMF and CSB to determine any differences in bird populations.
5. Conducted macroinvertebrate sampling at WMF and compared with sampling conducted by PA DEP to determine any differences in macroinvertebrate population;
6. Conducted vegetation sampling at WMF and CSB to determine any differences in plant communities.

Expected Completion: August 2014

Contacts: Andie Graham (agrah4@brockport.edu and Dr. Douglas A. Wilcox (dwilcox@brockport.edu)

Effects of stormwater ponds on calling amphibians

Objectives:

1. Examined 40+ stormwater ponds across eight sites in Monroe County, NY
2. Determined how surrounding land use, pond placement, and conditions within the pond affect amphibian species richness
3. Developed a better understanding of how factors at the local and landscape scale affect the suitability of these ponds for amphibians to provide recommendations to land managers on pond design and placement

Expected completion: August 2014

Contacts: John A. Bateman (jbate2@u.brockport.edu) and Dr. Christopher Norment (cnorment@brockport.edu)

Faunal responses to wetland restoration activities within Braddock Bay Fish and Wildlife Management Area, New York

Objectives:
1. Examine leopard frog (Lithobates pipiens) use of newly-created sedge/grass meadow habitat
2. Evaluate suitability of restored and created habitat for Black Tern (Chlidonias niger) and other focal species
3. Measure the success of the restoration by comparing abiotic and biotic responses to different restoration techniques against controls

Expected completion: December 2015
Contacts: John A. Bateman (jbate2@u.brockport.edu), Dr. John M. Farrell (jmfarrell@esf.edu), and Dr. Douglas A. Wilcox (dwilcox@brockport.edu)

Effects of phosphorus, hydrology, and agriculture on the invasive cattail Typha x glauca in Lake Ontario coastal wetlands

Objectives:
1. Determine effects on above- and below-ground biomass by varying levels of phosphorus and hydroperiod on Typha x glauca in a greenhouse setting.
2. Determine density of Typha x glauca in 18 Lake Ontario coastal wetlands; six each of HGMs Barrier Beach, Riverine, and Lacustrine.
3. Analyze potential relationship between wetland HGM type, size of wetland watershed, proportion of agriculture in watershed, total phosphorus in wetland water, and cattail density.

Expected completion: August 2014
Contacts: Aaron Heminway (ahemi1@u.brockport.edu) and Dr. Douglas A. Wilcox (dwilcox@brockport.edu)

Evaluation of floristic recovery in Great Lakes coastal wetland restoration projects - Braddock Bay Fish and Wildlife Management Area

Objectives:
1. Investigate groundwater hydrology to evaluate the timing, duration, and frequency of water-table changes during the growing season for sedge-grass meadow threshold criterion and Typha survival.
2. Conduct comprehensive geospatial surveys to serve as the basis for detailed plans illustrating microtopographical landform variations that may impact restoration objectives.
3. Ensure precise adequate elevations and water levels for channel and pothole creation and subsequent spoil placement for sedge regeneration.
4. Determine areas with viable remnant sedge-grass meadow and summarize the prevalence of native and non-native plant cover in each vegetation zone.
6. Characterize the likely species composition following a disturbance, particularly with respect to the potential for self-design following restoration implementation.
7. Summarize the occurrence of native and non-native germinated wetland plant seedlings to guide SGM restoration and evaluate target species propagation, with consideration given to eventual dredge spoil "upland" (seed-bank study).
9. Assess revegetation efforts to support sedge-grass meadow connectivity.

Expected completion: September 2016
Contacts: Eli L. Polzer (epolz1@brockport.edu) and Dr. Douglas A. Wilcox (dwilcox@brockport.edu) ■

WEB TIP

Resources at your fingertips!

For your convenience, SWS has compiled a hefty list of wetland science websites, books, newsletters, government agencies, research centers and more, and saved them to sws.org. Find them on the Related Links page **at sws.org.**

Know something we missed? Please forward your resource suggestions to mczosek@sws.org.

U.S. National Ramsar Committee Selects New Officers

Professor Bill Mitsch, Eminent Scholar and Director of the Everglades Wetland Research Park, Florida Gulf Coast University (Naples, FL), was approved as Chair of the United States National Ramsar Committee at a meeting of the Committee held at the U.S. Fish & Wildlife Service in Arlington Virginia on May 8, 2014. Suzanne Pittenger-Slear, President of Environmental Concern (St. Michaels, MD) was chosen as Vice-Chair and Ralph Tiner, Association of State Wetland Managers (Windham, ME) was chosen as Treasurer. Deborah Hahn of the Association of Fish and Wildlife Agencies (Washington DC) was renewed as Secretary of the Committee.

The United States National Ramsar Committee (USNRC) is an organization formed to support the goals and objectives of the Ramsar Convention on Wetlands within the United States and internationally. The USNRC provides support and advice to initiatives that promote the conservation and wise, sustainable use of domestic and international wetlands.

"Our committee goal for the coming year is simple—to increase the number of Ramsar Wetlands of International Importance in the USA" said Committee Chair Bill Mitsch. "We will be visiting with state and local wetland managers over the next year, encouraging them to nominate some of the many incredible wetlands in the USA that are not yet on our Ramsar list. It is important that we link our strong national history of wetland science, management, and protection better with the international community."

Members of the United States National Ramsar Committee include representatives of United States nongovernmental organizations NGOs, both nonprofit and for-profit, and local and state governmental organizations that have an interest in supporting the objectives of the Ramsar Convention on Wetlands. The Committee has as its mission to support the mission of the Ramsar Convention in the USA and to encourage and facilitate the development of wetlands of international importance in the USA and encourage their proper management.

The Convention on Wetlands, formally called the "Ramsar Convention" is an intergovernmental treaty that embodies the commitments of its member countries to maintain the ecological character of their Wetlands of International Importance and to plan for the "wise use", or sustainable use, of all of the wetlands in their territories. Unlike the other global environmental conventions, Ramsar is not affiliated with the United Nations system of Multilateral Environmental Agreements (MEAs), but it works very closely with the other MEAs and is a full partner among the "biodiversity-related cluster" of treaties and agreements. It has its international headquarters in Gland, Switzerland.

The Missisquoi Delta and Bay Wetlands site was recently designated and is the 36th U.S. Ramsar site (see June issue of *Wetland Science and Practice* for summary article). This addition represents a 50% increase in the number of USA Wetlands of International Importance since 2008, a postive reflection on the leadership provided by previous US National Ramsar Committees. Click here to learn more about the US Ramsar National Committee and its activities. ■

Federal Clean Water Act News

Earlier this year, the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers published proposed interpretation of waters of the United States ("Definition of the 'Waters of United States' Under the Clean Water Act"). The proposed rule was published in the *Federal Register* on Monday, April 21, 2014. The proposal is open for public comment for 182 days and will close on Monday, October 20, 2014. In response to this proposed rule, the House has conducted hearings in a couple of committees. On July 11, Representative Southerland (FL) introduced a new bill – "The Waters of the United States Regulatory Overreach Protection Act" (H.R. 5078; https://www.govtrack.us/congress/bills/113/hr5078) that focuses on prohibiting EPA and the Corps from "developing, finalizing, adopting, implementing, applying, administering, or enforcing" the proposed rule and any successor document "as the basis for any rulemaking or decision regarding the scope or enforcement of the Federal Water Pollution Control Act." From the Senate, a bill "Protecting Water and Property Rights Act of 2014" (S. 2496) with similar purpose has been introduced (http://www.washington-watch.com/bills/show/113_SN_2496.html).

News releases on these actions can be accessed via Wetland Breaking News (http://www.aswm.org/news/wetland-breaking-news/6695-wetland-breaking-news-national-news-july-2014). ■

This section is devoted to recording observations of plant and animal activity in wetlands. If you would like to participate in recording your observations of life in the wetlands, please let me know by email (rtiner@eco.umass.edu). In your email, please put "WSP Nature Observations" in the subject box and in your response please indicate your geographic area and specific interest. Special thanks to all who contributed to this issue! The following material has been extracted from their observations. Most of the emphasis for this issue is on the contributor's observations of flowers in these locales. It is not intended to be a record of the "first flowering" of referenced species since the observations are not necessarily scheduled to coincide with this event.

NORTHEAST

Observations from Maine

Ralph Tiner reports:

On July 1 in freshwater wetlands in South Portland (Cumberland County) the following species were flowering: *Lysimachia terrestris, Thalictrum pubescens, Carex vulpinoidea, C. lurida, Glyceria striata, Typha latifolia, Juncus effusus, Schoenoplectus tabernaemontani, Scirpus microcarpus*, and *Rosa palustris*. The flowers of *Ilex verticillata* were just beginning to open, while some flowers in *Spiraea alba* var. *latifolia* were blooming yet most were not.

On July 16 in a salt marsh at Rachel Carson National Wildlife Refuge (York County) *Glaux maritima, Spartina patens*, and *Calystegia sepium* were in bloom, with *Spartina alterniflora* just beginning to flower. Fruit capsules were present on *Triglochin maritima* while the succulent stems of *Salicornia maritima* were about 12 cm tall.

Blue flag Iris *versicolor*, Ralph Tiner

Observations from New Hampshire

Ralph Tiner reports:

On June 26, in freshwater wetlands contiguous with the salt marsh at the Great Bay Discovery Center (Rockingham County), the following species were flowering: *Rosa palustris, Calystegia sepium, Iris versicolor, Thalictrum pubescens,* and *Solanum dulcamara*. *Osmunda regalis* and *O. cinnamomea* were past flowering but fertile spikes were present. Mature achenes were seen in *Carex crinita*. In the brackish marsh, *Schoenoplectus robustus* was flowering, while *Typha angustifolia* were still developing their fertile spikes (marsh had recently been burned). In another salt marsh at Great Bay, *Argentina anserina* was flowering in the salt marsh and *Carex palaea* mature spikes along the upland border.

Flowering spike formed in *Clethra alnifolia*, but not flowering. *Ilex verticillata* some in flower and other buds unopened. Ripe berries were found on *Amelanchier canadensis*, whereas others had immature berries including *Aronia arbutifolia, A. melanocarpa, Vaccinium corymbosum,* and *Toxicodendron radicans*. *Quercus bicolor* had immature acorns.

Observations from Massachusetts

Ralph Tiner reports:

On May 30, along a created pond in Leverett (Franklin County), *Ledum groenlandicum* was in flower (saw this about a week ago), *Chamaedaphne calyculata* now going to fruit (no more flowers). *Vaccinium corymbosum* still had some flowers but fruits forming. *Rosa nitida* fully leafed out but still no sign of flower buds. Ornamental varieties of *Nymphaea odorata* have finally reached the water's surface (water level also dropped over the past couple of weeks). Leaves of *Pontederia cordata* have emerged about 1 cm above the water's surface but are still quite small. *Iris versicolor* is about 30 cm tall but still no flowers. Some leaves of *Cephalanthus occidentalis* are emerging (largest are about 3 cm long at this time). *Eupatorium perfoliatum* is about 30 cm, while stems of *Lobelia cardinalis* are now rising from overwintering rosettes, some nearly 15 cm tall. A few green frogs seen leaping from the bank. Haven't heard many spring peepers during the day lately but still chorusing plenty at night. I do hear a few more the gray treefrogs trills on occasion during the day.

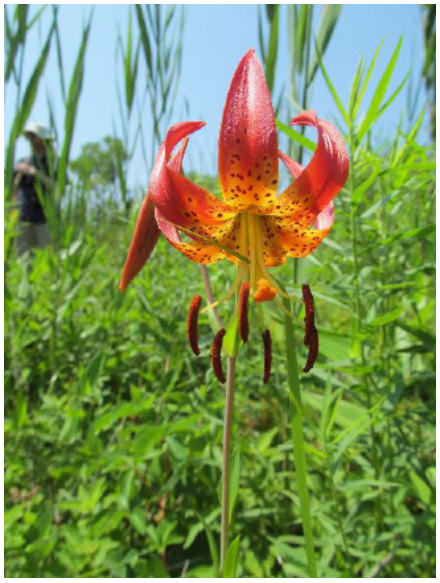
Saw a snapping turtle in the pond last week.

On July 19, in the same pond, *Cephalanthus occidentalis* and *Pontederia cordata* were flowering with *Helenium autumnale* in bloom along the margins. *Eupatorium perfoliatum* had unopened flower buds, while *Lobelia cardinalis* was about 30 cm tall but still lacking flowers or flower buds. In early August, *Lobelia* was in bloom.

Observations from Connecticut

Ralph Tiner reports:

On July 23 in a salt marsh at Barn Island State Wildlife Management area (New London County) the following species were in flower: *Agalinis maritima*, *Teucrium canadense*, and *Spartina patens*. *Cirsium horridulum* was well past flowering and seeds were dispersing. On the bank of an impoundment, *Lilium superbum* was just beginning to flower (a few in bloom, but most flower buds still not open). The tallest *Salicornia bigelovii* stems were about 15 cm high, most were much smaller, still need more time to reach maximum height.



Turk's Cap Lily *Lilium superbum*, Ralph Tiner

Buttonbush *Cephalanthus occidentalis*, Alicia Korol

Observations from New York

Eli Polzer reports:

On July 24 in a cattail marsh connected to Lake Ontario at Braddock Bay Wildlife Management Area (Monroe County) found a floating fen in the midst of *Typha* and submersed and floating-aquatic species. A quick assessment included monocots, such as: *Cladium mariscoides* in fruit, *Carex* (vegetative shoots only), a patch of native *Phragmites australis* ssp. *americana* in formative inflorescence development, *Juncus* sp. in fruit, *Typha* sp. in flower, *Eriophorum virginicum* with immature flowers, *Scirpus atrovirens* in fruit, and what appeared to be evidence of last year's growth of *Andropogon*. *Sphagnum (*most likely *capillifolium)* hummocks (gametophyte stage) were present in various rubicund hues. Other taxa included *Vaccinium macrocarpon* with senescing flowers, but fruiting in full and succulent glory, *Drosera rotundifolia* (lacking flowers), *Triadenum* sp. in flower, and *Lysimachia thyrsiflora* having shed their luxuriant flowers. Woody species included *Rosa palustris* in flower, *Myrica gale, Acer rubrum* and *Cephalanthus occidentalis* in flower. Ferns such as *Thelypteris palustris*, *Osmunda regalis*, and *Osmunda cinnamomea* were present, although none had yet developed fertile fronds or leaflets. Northern leopard frogs were constant companions.

Observations from New Jersey

Ralph Tiner reports:

On May 6 in the Great Swamp (Basking Ridge, Somerset County), the forested wetland was fully leafed out. The following species were flowering: *Rosa multiflora*, *Viburnum dentatum*, *Eleocharis* sp., *Phalaris arundinacea*, *Iris pseudacorus*, *Iris versicolor*, *Packera aurea*, and *Sambucus nigra*. Flowers were just starting to bloom in *Cornus amomum* and *C. racemosa*. Flower buds were forming in *Impatiens capensis* and still not opened in *Lyonia ligustrina*. Flower clusters were nearly completely emerged in *Juncus effusus*. Perigynia were observed in several *Carex* sedges (including *stricta*, *lurida*, *vulpinoidea*, *canescens*, and *tribuloides*), while *Carex crinita* bore mature seeds. *Scirpus cyperinus* still lacked any sign of a flower stalk. Immature berries were found on *Vaccinium corymbosum*, whereas *Ebotrys racemosa* had spent flowers and fruit capsules beginning to form. The fertile fronds of *Onoclea sensibilis* were emerging and starting to unfurl.

Southeast

Observations from Virginia

Bill Sipple reports:

On June 24, at a mitigation wetland near Fredricksburg heard a red-shouldered hawk, the broken banjo twangs of green frogs and the clicking of northern cricket frogs; also saw a mole cricket (an insect not often seen due to its burrowing habit) and fisher spiders. *Galium tinctorium* was flowering, while *Eupatorium perfoliatum* was not yet flowering. *Juncus acuminatus* already had brown glomerules and is fruiting with mature seeds, whereas the taller, later-flowering *Juncus canadensis* had green glomerules yet had not begun to flower. *Juncus effusus* was in fruit. A few sedges had achenes (e.g., *Carex lurida*, C. *vulpinoidea*, and C. *scoparia*), while some were in flower (*Eleocharis obtusa*, *Schoenoplectus americanus,* and *Cyperus pseudovegetus*) and others had only immature inflorescences (*Scirpus cyperinus* and *Cyperus strigosus*). Three panic grasses were present, but only one, *Dichanthelium dichotomum* had mature spikelets, while *Dichanthelium scoparium* and *Dichanthelium clandestinum* had immature fruits. *Leersia oryzoides* was not yet flowering. Three shrubs, *Cephalanthus occidentalis, Hypericum prolificum*, and *Sambucus nigra* had immature fruits. *Prunus serotina* fruits were still

green and its young overwintering axillary buds were already showing. The buds of *Platanus occidentalis* were hidden beneath leaf petiole bases.

Alicia Korol reports:

On May 9, the following species were seen along a stream bank and floodplain at George Mason University, Fairfax Campus: *Arisaema triphyllum* with a black flowering spike, *Claytonia virginica* in bloom, *Symplocarpus foetidus* with leaves full and spreading and no sign of flowers, *Smilax walteri* with small flower buds, and *Viburnum recognitum* with flower buds. Also saw the following in riparian wetlands along Accotink Trail (Fairfax County): two *Prunus serotina* trees - one tree getting ready to bloom and another partially blooming, *Carpinus caroliniana* bearing winged fruits, *Liriodendron tulipifera* flowers starting to appear, *Toxicodendron radicans* with flower buds, and several (>10) of a larger group of *Podophyllum peltatum* flowering.

On June 3 from a campus pond at George Mason University, Fairfax Campus, observed: *Impatiens capensis* yet no flowers, and flowers on the several graminoids (*Juncus effusus, Juncus canadensis*, *Carex vulpinoidea*, *Carex seorsa*, *Eleocharis rostellata and Carex lupuliformis*). Two species had almost finished flowering: *Iris pseudacorus* (with one ragged flower) and *Liriodendron tulipifera* (with only a handful of flowers remaining). *Rumex crispus* was now red-tinged. It was still too early still for *Pontederia cordata* flowers. *Parthenocissus quinquefolia* bore clusters of buds. From neighboring riparian wetlands, *Thalictrum pubescens* displayed promising green flower buds, *Thelypteris thelypteroides* were present but lacking sporangia, *Ranunculus septentrionalis* had already flowered and bore seed pods and *Viburnum dentatum* was in full bloom.

On June 8 in riparian wetlands along Accotink Trail (Fairfax County): *Impatiens capensis* stood about tall 30-60 cm tall but no signs of flowers were noted, some *Carpinus caroliniana* bore fruit nutlets, others still had catkins, one with both; many graminoids were flowering including

Elephant Heads *Pedicularis groenlandica*, Ralph Tiner

Star Gentian *Swertia perennis*, Ralph Tiner

Carex vulpinoidea, *C. tribuloides, Scirpus atrovirens* and *Juncus effusus*. The spathe and spadix of *Arisaema triphyllum* were gone, but present were the berries bundled and ensheathed with white casing. V*iburnum dentatum* was in bloom, with inflorescences starting to senesce. *Onoclea sensibilis* bore its fertile frond. The leaves of *Podophyllum peltatum* were still standing but looking weathered and speckled with yellow; no flowers or fruits. Most of the flowers from *Toxicodendron radicans* were gone and plenty of berries present.

On June 14 on a floodplain at Bull Run Park, Clifton (Fairfax County) observed flower buds on the invasive *Polygonum perfoliatum* which was observed in flower the next day in a nearby location (Accotink Creek).

On June 15 on the floodplain of Accotink Creek (Fairfax County), many species were in bloom including

Albizia julibrissin, *Asclepias syriaca*, *Vitis riparia*, and Toxicodendron radicans. *Eupatoriadelphus fistulosus* was about 75 cm tall and had a set up for inflorescences but no flower buds yet. Ribbed nutlets still on *Carpinus caroliniana*.

On June 25 at the ~15-year old North Fork Mitigation Bank (Haymarket, Prince William County), the following species were flowering: *Verbena hastata*, *Sagittaria latifolia*, *Impatiens capensis, Pontederia cordata*, *Nymphaea odorata*, *Salix nigra* (only one of out of hundreds still flowering), *Asclepias incarnata*, *Schoenoplectus tabernaemontani*, and *Alisma plantago-aquatica*. *Cephalanthus occidentalis* was just starting to bloom with one ball of many in the cluster on the end of twigs flowering. Fruits observed on *Fraxinus pennsylvanica*, while *Sambucus nigra* bore unripe, green fruits and a few flowering clusters.

On July 7 in riparian wetlands along Accotink Creek (Fairfax County): *Toxicodendron radicans* still fruiting, *Carpinus caroliniana* still with ribbed fruit nutlets, only a few of large stands of *Impatiens capensis* flowering, fruits of *Arisaema triphyllum* unripe and green, *Boehmeria cylindrica* with flowering stalks, *Thelypteris thelypteroides* with sporangia, *Geum canadense* with globe-shaped flowering heads but few petals, *Lysimachia ciliata* with nodding flowers, *Platanus occidentalis* with round fruit balls, and acorns on *Quercus rubra*.

On July 13, in and around a marsh at Huntley Meadows Park (Fairfax County), *Sparganium americanum* had flower balls high on stalk above senesced flower balls on lower stalk; *Saururus cernuus*, *Mikania scandens*, *Campsis radicans*, and *Scirpus cyperinus* were flowering, while *Hibiscus moscheutos* had multiple flower buds ready to bloom and berries were observed on *Viburnum recognitum* (some blue, some green), *Smilax rotundifolia* (blue), *Sambucus nigra* (ripening pink and purple fruits), and *Ilex verticillata* (green).

Mountain West

Observations from Colorado

Ralph Tiner and Gay Austin report:

On August 13, in several fens in Gunnison County, the following species were in bloom: *Swertia perennis, Gentiana affinis, Mimulus guttatus, Dasiphora (Potentilla) fruticosa, Polemonium occidentale, Saxifraga hirculus, Epilobium saximontanum, Pedicularis groelandica, Rhodiola rhodantha, Polygonum bistoroides, Achillea millifolium,* and *Geum macrophyllum*. Several sedges have gone to seed including *Carex buxbaumii, C. canescens, C. diandra, C. utriculata, Eriophorum angustifolium,* and *Eleocharis quinqueflora*. Catkins had formed in *Betula glandulosa*. A buck mule deer was observed in one fen while some cattle were observed in another and in riparian *Salix* wetlands.

Pacific Northwest

Observations from Washington State

Jonathan Kemp reports:

On July 1, 2014 from West Hylebos Creek with an associated riverine wetland in Milton (Pierce County): *Alnus rubra* and *Populus balsamifera* var. t*richocarpa* trees were showing signs of stress (leaf yellowing, curl, and drop) due to lack of precipitation for over 40 days, while *Fraxinus latifolia* and *Salix* spp. were doing well, having sufficient near surface groundwater (<1 feet below the ground surface). Patches of *Rubus spectabilis* and *Cornus sericea* were in full seed mode and loaded with ripening fruit; leaf cover was extensive at over 95 percent aerial cover and the plants show no signs of weather-related stress. *Lysichiton americanus*, *Carex obnupta*, *Athyrium filix-femina*, *Hydrophyllum tenuipes*, and *Stachys mexicana* were fully developed and mature, flowers have past and fertile seeds are ripening. Invasive *Impatiens capensis* and *Phalaris arundinacea* have overtaken their respective areas with *Impatiens* dominant in shady areas under the canopy of *Rubus spectabilis* and *Cornus sericea*, and *Phalaris arundinacea* dominant in open sunny areas along the creek edge extending out to the edge of the floodway in areas without dominant shrub cover.

Maki Dalzell reports:

On May 13, in a riverine wetland along Cove Creek on Vashon Island (King County): the left bank of the stream was dominated by large clumps of *Lysichiton americanus* and *Ranunculus repens*. The wetland was located under the canopy of *Alnus rubra* and was mostly shaded. Unopened flower buds of *L. americanus* were observed. Some *Ranunculus repens* were flowering. *Rubus spectabilis* were past flowering and bore orange fruits.

On May 29, in a depressional wetland along Hylebos Creek in Federal Way (King County), *Salix lasiandra* and *Salix sitchensis* had both female and male catkins flowering. A red-breasted sapsucker was observed in the willows along the stream bank singing out loud. All herbaceous plants are flowering including *Scirpus microcarpus*, *Juncus effusus*, *Ranunculus repens*, *Phleum pratense*, and *Phalaris arundinacea*. Pollens from *Phleum pratense*, and *Phalaris arundinacea* were so abundant in air and were making biologists sneeze everytime we walked by. ■

Pothole Wetlands, continued from page 14

The study estimated 6,427,350 acres of wetlands were in the PPR in 2009. Emergent wetlands made up about 87.7 percent of the total wetland area and 93 percent of all wetland basins in the PPR.

Between 1997 and 2009, total wetland area declined by an estimated 74,340 acres (30,100 ha) or 1.1 percent in the PPR. This represents an average annual net loss of 6,200 acres. Between 1997 and 2009 wetland/water basins declined by over 107,177 or 4 percent. Wetland basin numbers declined in every state in the PPR with the exception of Montana. Ninety six percent of the basins lost were temporarily flooded emergent and farmed wetlands as these basin types declined by 7.8 percent. The mean size of the basins lost was 0.85 acres. Changes in wetland extent and type between 1997 and 2009 were the result of cumulative impacts related to ecological change; changes in climate that altered hydrology (e.g. flooding); anthropogenic changes such as draining, ditching or filling wetlands; or a combination of these influences.

Results also estimated grasslands occupied approximately 21.1 million acres (8.6 million ha) in the PPR in 2009. Grassland area declined by an estimated 568,040 acres or 2.6 percent. There was a three to one ratio of grassland to wetland region-wide. The loss of grassland in the PPR is particularly disturbing because this has been shown to seriously reduce bird populations and influence sedimentation rates and impair water quality in remaining wetlands and surface waters.

For more information download the complete report at: http://www.fws.gov/wetlands/Documents/Status-and-Trends-of-Prairie-Wetlands-in-the-United-States-1997-to-2009.pdf ■

WETLAND BOOKSHELF

The following are a list of some new and recent publications (2013-2014) that may be of interest. If you know of others please send the information to the WSP Editor for inclusion in future editions of Wetland Science and Practice.

BOOKS

- Black Swan Lake – Life of a Wetland http://press.uchicago.edu/ucp/books/book/distributed/B/bo15564698.html
- Coastal Wetlands of the World: Geology, Ecology, Distribution and Applications http://www.cambridge.org/us/academic/subjects/earth-and-environmental-science/environmental-science/coastal-wetlands-world-geology-ecology-distribution-and-applications
- Florida's Wetlands http://www.pineapplepress.com/ad.asp?isbn=978-1-56164-687-6
- Mid-Atlantic Freshwater Wetlands: Science, Management, Policy, and Practice http://www.springer.com/environment/aquatic+sciences/book/978-1-4614-5595-0
- Progress Toward Restoring the Everglades: The Fifth Biennial Review http://www.nap.edu/catalog.php?record_id=18809&utm_medium=etmail&utm_source=The%20National%20Academies%20Press&utm_campaign=NAP+mail+new+2014-07-01+w+blurbs&utm_content=Downloader&utm_term
- The Atchafalaya River Basin: History and Ecology of an American Wetland http://www.tamupress.com/product/Atchafalaya-River-Basin,7733.aspx
- Tidal Wetlands Primer: An Introduction to their Ecology, Natural History, Status and Conservation https://www.umass.edu/umpress/title/tidal-wetlands-primer
- Wetland Landscape Characterization: Practical Tools, Methods, and Approaches for Landscape Ecology http://www.crcpress.com/product/isbn/9781466503762
- Wetland Techniques (3 volumes) http://www.springer.com/life+sciences/ecology/book/978-94-007-6859-8

ONLINE PUBLICATIONS

U.S. Army Corps of Engineers, Wetland Research Technology Center

- A Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing Wetland Functions of Forested Wetlands in Alluvial Valleys of the Coastal Plain of the Southeastern United States ERDC/EL TR-13-1
- Hydrogeomorphic (HGM) Approach to Assessing Wetland Functions: Guidelines for Developing Guidebooks (Version 2) ERDC/EL TR-13-11
- Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing the Functions of Flat and Seasonally Inundated Depression Wetlands on the Highland Rim ERDC/EL TR-13-12
- Identification, Development, and Release of Insect Biocontrol Agents for the Management of *Phragmites australis* http://acwc.sdp.sirsi.net/client/search/asset/1035680
- Case Study: Sensitivity Analysis of the Barataria Basin Barrier Shoreline Wetland Value Assessment Model http://acwc.sdp.sirsi.net/client/search/asset/1035608

U.S. Fish and Wildlife Service, National Wetlands Inventory

- Connecticut Wetlands Reports
- Changes in Connecticut Wetlands: 1990 to 2010
- Potential Wetland Restoration Sites for Connecticut: Results of a Preliminary Statewide Survey
- Wetlands and Waters of Connecticut: Status 2010
- Connecticut Wetlands: Characterization and Landscape-level Functional Assessment
- Rhode Island Wetlands: Status, Characterization, and Landscape-level Functional Assessment http://www.aswm.org/wetlandsonestop/rhode_island_wetlands_llww.pdf
- Status and Trends of Prairie Wetlands in the United States: 1997 to 2009 http://www.fws.gov/wetlands/Documents/Status-and-Trends-of-Prairie-Wetlands-in-the-United-States-1997-to-2009.pdf
- Status and Trends of Wetlands in the Coastal Watersheds of the Conterminous United States 2004 to 2009. http://www.fws.gov/wetlands/Documents/Status-and-Trends-of-Wetlands-In-the-Coastal-Watersheds-of-the-Conterminous-US-2004-to-2009.pdf
- The NWI+ Web Mapper – Expanded Data for Wetland Conservation http://www.aswm.org/wetlandsonestop/nwiplus_web_mapper_nwn_2013.pdf
- Wetlands One-Stop Mapping: Providing Easy Online Access to Geospatial Data on Wetlands and Soils and Related Information http://www.aswm.org/wetlandsonestop/wetlands_one_stop_mapping_in_wetland_science_and_practice.pdf
- Wetlands of Pennsylvania's Lake Erie Watershed: Status, Characterization, Landscape-level Functional Assessment, and Potential Wetland Restoration Sites http://www.aswm.org/wetlandsonestop/lake_erie_watershed_report_0514.pdf

U.S. Forest Service

Historical Range of Variation Assessment for Wetland and Riparian Ecosystems, U.S. Forest Service Rocky Mountain Region. http://www.fs.fed.us/rm/pubs/rmrs_gtr286.pdf

U.S. Geological Survey, National Wetlands Research Center

A Regional Classification of the Effectiveness of Depressional Wetlands at Mitigating Nitrogen Transport to Surface Waters in the Northern Atlantic Coastal Plain http://pubs.usgs.gov/sir/2012/5266/pdf/sir2012-5266.pdf

Tidal Wetlands of the Yaquina and Alsea River Estuaries, Oregon: Geographic Information Systems Layer Development and Recommendations for National Wetlands Inventory Revisions http://pubs.usgs.gov/of/2012/1038/pdf/ofr2012-1038.pdf

Publications by Other Organizations

Report on State Definitions, Jurisdiction and Mitigation Requirements in State Programs for Ephemeral, Intermittent and Perennial Streams in the United States (Association of State Wetland Managers) http://aswm.org/stream_mitigation/streams_in_the_us.pdf

Wetlands and People (International Water Management Institute) http://www.iwmi.cgiar.org/Publications/Books/PDF/wetlands-and-people.pdf

LINKS TO WETLAND-RELATED JOURNALS AND NEWSLETTERS

The following is a list of journals and newsletters that contain material on wetlands. If you have additions to recommend, please send the name and links to the WSP editor.

Journals

- Aquatic Botany http://www.journals.elsevier.com/aquatic-botany/
- Aquatic Conservation: Marine and Freshwater Ecosystems http://onlinelibrary.wiley.com/journal/10.1002/%28ISSN%291099-0755
- Aquatic Sciences http://www.springer.com/life+sciences/ecology/journal/27
- Ecological Engineering http://www.journals.elsevier.com/ecological-engineering/
- Estuaries and Coasts http://www.springer.com/environment/journal/12237
- Estuarine, Coastal and Shelf Science http://www.journals.elsevier.com/estuarine-coastal-and-shelf-science/
- Hydrobiologia http://link.springer.com/journal/10750
- Hydrological Sciences Journal http://www.tandfonline.com/toc/thsj20/current
- Journal of Hydrology http://www.journals.elsevier.com/journal-of-hydrology/
- Wetlands http://link.springer.com/journal/13157
- Wetlands Ecology and Management http://link.springer.com/journal/11273

Newsletters

- Wetland Breaking News (Association of State Wetland Managers) http://aswm.org/news/wetland-breaking-news
- National Wetlands Newsletter (Environmental Law Institute) http://www.wetlandsnewsletter.org/welcome/index.cfm

See additional books and resources at sws.org.

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